

e. **Remarks**

**OBVIOUSNESS REJECTIONS**

A) At page 2, the Office Action rejects claims 1, 6, 8, 10 – 13, and 15 – 19 as being obvious over a combination of an article of Paiella et al at IEEE Transactions on Photonics Technology Letters Vol. 12, No. 7 (2000) pages 780 – 782 (Herein, referred to as Paiella.); U.S. Patent Application Publication 2002/0181059 of Christopher (Herein, referred to as Christopher.); U.S. Patent 6,816,682 of Ionov et al (Herein, referred to as Ionov.); U.S. Patent 6,823,141 of Miyauchi et al (Herein, referred to as Miyauchi.); an article of Lau et al at IEEE Journal of Quantum Electronics Vol. QE-21, No. 2 (1985) pages 121 – 138 (Herein, referred to as Lau.), and U.S. Patent 6,974,068 of Adachi et al (Herein, referred to as Adachi.).

**Claims 1 and 13**

Pending claim 1 recites:

the modulating including DC biasing a pumping voltage for the mid-IR laser to be 0.001 volts to 0.1 volts from a lasing threshold of the mid-IR laser; ...

(underlining added).

Pending claim 13 recites:

the modulator is configured to DC bias a pumping voltage for the mid-IR laser to be 0.001 volts to 0.1 volts from a lasing threshold of the mid-IR laser.

(underlining added).

With respect to the above limitations, the Office Action admits that:

Paiella et al. does not mention the bias voltage.

Office Action, page 4, lines 17 – 18.

Then, between page 5, line 18, and page 6, line 4, the Office Action argues that the laser of Paiella would have inherently operated at a DC bias voltage that is either 0.1 volts or 0.05 volts from the lasing threshold, i.e., within the above ranges.

The Office Action bases its argument on properties of diode semiconductor lasers that are not similar to the Quantum cascade (QC) laser described in Paiella. In the rejection, the Office Action relies on Figure 13 of Lau and Fig. 44 of Adachi, which both illustrate PN diode lasers, i.e., semiconductor interband lasers, rather than the unipolar QC lasers described in Paiella. See, e.g., the second paragraph of the description of “Quantum cascade laser” at <http://en.wikipedia.org> (attached) for a description of the significant differences between ordinary diode semiconductor lasers (i.e., interband lasers) and QC lasers. Due to these important differences, there would have been no reason to expect that the cited lasers of Lau and Adachi would have the same DC bias

voltages as the lasers of Paiella. For these reasons, the argument of the Office Action that the DC biasing limitation of pending claims 1 and 13 is inherent in Paiella is incorrect.

Herein, Applicants also submit a declaration made by Professor Rainer Martini (Herein referred to as the Declaration.). Professor Martini is one of the inventors in the present application. Professor Martini is also an expert in laser physics related to optical communications and spectroscopy.

In the Declaration, par. 9, Professor Martini states that Paiella references an article of Gmachl et al,<sup>1</sup> which describes specific QC lasers, when describing Paiella's own QC lasers. That is, Paiella implies that its QC lasers are either very similar to the lasers of Gmachl or are the lasers described by Gmachl. In the Declaration, pars. 10 – 11, Professor Martini also evaluates, in detail, the DC biasing threshold that would be applied to the lasers of Gmachl if said lasers were operated according to the modulation and biasing schemes disclosed in Paiella. Based on his analysis, Professor Martini concludes at par. 11 of the Declaration that the DC bias of such QC lasers would be 0.478 volts below their lasing threshold if operated as described in Paiella. That is, Professor Martini concludes, i.e., after a detailed analysis on lasers that Paiella references to describe its own lasers, that said lasers would be operated at a DC bias voltage largely outside of the range recited in pending claims 1 and 13 when operated as taught in Paiella. For the above reasons, Paiella does not explicitly or inherently disclose the above-recited modulating and modulator limitations of pending claims 1 and 13.

Thus, the Office Action does not provide a prima facie case of obviousness for either pending claim 1 or pending claim 13.

**Dependent claims 6, 8, 10 – 12, and 15 – 19**

Dependent claims 6, 8, and 10 – 12 are non-obvious over the art as applied in the Office Action, at least, by their dependence on claim 1. Dependent claims 15 – 19 are non-obvious over the art as applied in the Office Action, at least, by their dependence on claim 13.

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<sup>1</sup> The article is: "High-power  $\lambda \approx 8 \mu\text{m}$  quantum cascade lasers with near optimum performance", Claire Gmachl et al, Applied Physics Letters, Vol. 72, No. 24 (June 15, 1998) pages 3130 – 3132 (Herein, referred to as the "Gmachl article").

**B) At page 5, the Office Action rejects claims 2, 7, and 9 as obvious over a combination of the Paiella, Christopher, Lau, and Adachi.**

**Claim 2**

Pending claim 2 recites:

the modulating including DC biasing a pumping voltage for the mid-IR laser to be 0.001 volts to 0.1 volts from a lasing threshold of the mid-IR laser ...

(underlining added).

With respect to the above limitations, the Office Action admits that:

Paiella et al. does not mention the bias voltage.

Office Action, page 7, lines 12 - 13.

Then, at page 7, line 13 – 21, the Office Action presents an argument that the laser of Paiella would have inherently operated at a DC bias voltage that is either 0.1 volts or 0.05 volts from the lasing threshold. Indeed, the Office Action's argument is substantially the argument already presented between page 5, line 18, and page 6, line 4, with respect to the rejection of claims 1 and 13. Thus, for the same reasons discussed with respect to the rejections of claims 1 and 13, the DC biasing limitation of pending claim 2 is not inherent in Paiella, and Paiella would have suggested to one of skill in the art a DC biasing that is very different than the DC biasing recited in pending claim 2.

For the above reasons, the Office Action does not provide a prima facie case of obviousness for pending claim 2.

**Dependent claims 7 and 9**

Dependent claims 7 and 9 are non-obvious over the art as applied in the Office Action at least by their dependence on claim 2.

**C) At page 8, the Office Action rejects claim 3 as obvious over a combination of Paiella, Christopher, Ionov, Lau, Adachi, and U.S. Patent 6,549,556 of Hwang et al (Herein, referred to as Hwang.).**

Dependent claim 3 is non-obvious over the art as applied in the Office Action, at least, by its dependence on claim 2.

**D) At page 8, the Office Action rejects claim 20 as obvious over a combination of Paiella, Christopher, Ionov, Miyauchi, Lau, Adachi, and U.S. Patent 6,016,212 of**

**Durant et al.**

Dependent claim 20 is non-obvious over the art as applied in the Office Action, at least, by its dependence on claim 13.

**E) At page 9, the Office Action rejects claims 21 – 22 as obvious over a combination of Paiella, Christopher, Ionov, Miyauchi, Lau, Adachi, and Hwang.**

Dependent claims 21 – 22 are non-obvious over the art as applied in the Office Action, at least, by their dependence on claim 13.

**F) At page 10, the Office Action rejects claims 14, and 23 – 24 as obvious over a combination of Paiella, Christopher, Ionov, Miyauchi, Lau, Adachi, and “Optical Networks: a Practical Perspective” by Ramaswami et al, Academic Press (1998) pages 177 – 180.**

Dependent claims 14 and 23 – 24 are non-obvious over the art as applied in the Office Action, at least, by their dependence on claim 13.

**Conclusion**

For the above reasons, Applicant respectfully requests that the claims be allowed as currently pending.

In the event of any non-payment or improper payment of a required fee, the Commissioner is authorized to charge or to credit **Lucent Technologies Deposit Account No. 12-2325** to correct the error.

Respectfully,



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